RUFORUM Working Document Series (ISSN 1607-9345), 2019, No. 18 (1): 618 - 631.
Available from http://repository.ruforum.org

Research Application Summary

Implications of digitalization on individual's wellbeing in Cameroon

Pamen, F.P.E. & Yepndo, D.G.C.

University of Yaounde, P.O.Box 337, Yaoundé, Cameroon
University of Dschang, P.O. Box 96, Dschang, Cameroon
Corresponding author: feubi.pameneric@yahoo.fr / pamen_2003@yahoo.fr

Abstract

In this study, we used a tractable econometric model focusing on individual wellbeing captured through expected income in a given location, as the main economic determinant of the use of digital technologies in Cameroon. The model is estimated using panel data from the National Institute of Statistics on individuals who achieved at least the post-secondary education level, aged above 25 years old and heading a household. Our main findings is that using digital technology is substantially influenced by income prospects. We see that, distance between main cities from the previous position, characteristics/standards of house, place of living (rural/urban), marital status and household's size are significant as per regard to the decision of an individual to change his/her current position through moving to digital technologies as the required condition. Individual's age, level of education (more than post-secondary achieved), and current status in employment (wage/ grade /year of experience) are also significant. Controlling for these parameters, moving decision to digital technologies and changing the current position are significantly affected by expected wage/ grade in the new position. The elasticity of the relationship between wage and digital technologies use is closed to 0.75. Such results stand like an optimal search of the best wage matching with the position of an individual in a given place. Workers receiving their expected income in the current position have a great probability to stay without being tempted to use digital technologies to move to another position. Achieving the 2020 connect agenda "internet access for all", in Cameroon could be suitable for individuals to really improve their wellbeing. We suggest to policy makers development of ICTs infrastructure all over the country. That may lead to an inclusive approach of promoting economic growth and share prosperity.

Keys words: Cameroon, digitalization, discrete choice model, wellbeing

Résumé

Dans cette étude, nous avons utilisé un modèle économétrique traçable se concentrant sur le bien-être individuel enregistré sur base du revenu attendu dans un endroit donné, comme le principal déterminant économique de l'utilisation des technologies numériques au Cameroun. Le modèle a été évalué en utilisant des données du panel de l'Institut National des Statistiques sur les individus ayant atteint au moins le niveau d'éducation post-secondaire, âgés de plus de 25 ans et dirigeant un ménage. Notre principale conclusion est que l'utilisation des technologies numériques est fortement influencée par les perspectives de revenus. Nous avions constaté que la distance entre les principales villes et le poste occupé précédemment, les caractéristiques/standards de la maison, le milieu de vie (rural/urbain), le statut marital et la taille du ménage ont été significatifs en ce qui concerne la décision d'un individu de changer son poste actuel en passant aux technologies numériques comme condition requise. L'âge de l'individu, le niveau d'éducation (plus que le niveau post-secondaire) et le statut actuel dans l'emploi (salaire/grade/année d'expériences) ont été également significatifs.

En contrôlant ces paramètres, la décision de passer aux technologies numériques et de changer le poste actuel était significativement affectée par le salaire/grade attendu dans le nouveau poste. L'élasticité de la relation entre le salaire et l'utilisation des technologies numériques était proche de 0,75. Ces résultats s'apparentent à une recherche optimale du meilleur salaire correspondant au poste d'un individu dans un lieu donné. Les travailleurs qui perçoivent le revenu escompté à leur poste actuel ont une forte probabilité d'y rester sans être tentés d'utiliser les technologies numériques pour changer de poste. La réalisation de l'agenda 2020 Connect "accès à l'internet pour tous" au Cameroun pourrait permettre aux individus d'améliorer réellement leur bien-être. Nous suggérons aux décideurs politiques de développer l'infrastructure des TIC dans tout le pays. Cela pourrait conduire à une approche inclusive de la promotion de la croissance économique et de la distribution de la richesse.

Mots clés : Cameroun, numérisation, modèle de choix discret, bien-être

Introduction

Over the last decade, the development of the digital economy has created unprecedented opportunities for growth and inclusiveness within and between countries, regardless of the continent and sector. At the same time, the definition of digital economy has evolved with the underlying technology. Over the past several decades, the Information and Communication Technology (ICT) sector has undergone rapid development, from microelectronics in the 1940s, to the birth of the computer in the 1960s, the introduction of the internet in the 1990s, and most recently, blockchain, Artificial Intelligence (AI) and robotics. Correspondingly, new sectors based on the evolving technologies have emerged, such as e-commerce, fintech and driverless cars. In this increasingly interconnected world, digitalization stands like a driver for social and economic inclusion. It gives people and organizations of any size access to a global marketplace and repository of information. To the benefit of all economic sectors and consumers, it deepens and broadens trading patterns, takes productivity to a higher level, and scales up services. It allows customizing production, facilitates new forms of collaboration, accelerates access to knowledge, inspires innovation and entrepreneurship, and fosters competition. According to the World Bank (2016), digital economy represents around 5% of the global Gross Domestic Product (GDP) and 3% of global employment. Bukht and Heeks (2017) add that the global North has the lion's share of the digital economy but growth rates are fastest in the global South with more than 6% of GDP. Regarding the real impact of digitalization on productivity, theoretically digitalization can boost productivity, viewed in a growth accounting framework. A salient feature of the digital age is that data has become a new factor of production. This is in contrast to the industrial era, when only capital and labor were used as inputs. The amount of data available has been roughly doubling every two years, and data processing capacity doubles every eighteen months. In addition, a rising share of capital (K) and labor (L) will be using digital technologies to produce output. Yet an existing framework to measure the data stock in a production function is not available. However, by rearranging the production function, the contribution of digitalization could be captured in the Solow residual, hence higher TFP (A) growth. If we proxy the data stock with the size of digital economy, the contribution of digitalization alone could be filtered out. It is for all those reasons that stakeholders are on the track of achieving the 2020 connect agenda "internet access for all".

The emerging digital Media, Entertainment and Information Industries (MEII) offerings are for example the main drivers to smartphones, tablets, laptops, 3D printers, netbooks and others connected device adoption, as well as to our changing relationship with many other elements of daily life, such as health, consumer products and mobility. Between 2000 and 2019 in Cameroon, the number of internet users rose from 20,000 to 4,909,178 in 2017 and to 6,128,422 in 2019. This is an increase of about 99.67% in just more than a decade. Regarding the evolution of the number

of internet subscribers by operator and by access technologies, according to MINPOSTEL (2017), they are up to 8,045,324 between 2011 and 2016.

As around the world, people in Cameroon now spend more time using laptops, computers and smartphones than they do in other daily activities, and the time they spend connected is rising. This hyper-connectivity affects how individuals interact with one other, how they learn and work, in ways that are both profound and impactful.

The economics literature also establishes a positive relationship between digital technologies, productivity, growth and wellbeing. New digital technologies are particularly important to better connect disadvantaged groups (OECD, 2016b). For example, mobile connectivity in Cameroon helps in reaching remote populations as well as those with lower incomes, due to its low costs. Pantea and Martens (2014) reported that low-income users spend even more time on the internet than the average, browsing websites that deal with education, career opportunities, health and nutrition themes and online sales platforms. Potential benefits for low-income groups also relate to improved access to free or very low-cost knowledge and information; services that allow consumers to negotiate better prices for products (as well as identify better quality products); as well new consumption opportunities offered by Internet-based platforms.

Technological innovations in the financial and health sectors can also promote social inclusion. Digital lending innovations and innovative financing like peer-to-peer lending and crowdfunding platforms have the potential to fill a bank lending gap and improve access to finance for both households and small enterprises, allowing for the participation of small investors. Financial innovations will, however, require an appropriate regulatory and legal framework ensuring transparency and accountability. Tailored financial education programmes can enable individuals and small businesses to make use of these new opportunities and help them make informed choices. In the health sector, a study by Deloitte (2015) found that digital technologies enabled patients and healthcare professionals to access data and information more easily and improved the quality of outcomes of both health and social care.

What then are the implications of digitalization on individual's wellbeing in Cameroon? The objective of this paper is to capture the effects of digitalization on individual's wellbeing in Cameroon, since the introduction of internet in the country in 2000.

The interest of such a study for stakeholder is to know more about economic effects of digitalization and to look at how they can regulate it. Since they are on the track of achieving the 2020 connect agenda: "internet access for all", in the current context the post-2015 development agenda.

Literature review

A long-held tenet classical economic literature presents industrialization as the main growth's driver for emerging and low-income countries. Kaldor (1967) argues for example that the manufacturing sector promotes broad economic growth. According to Baumol (1967), the services sector is resistant to improvements in productivity. He assumed that the provision of services such as restaurant meals, haircuts or medical checkups, required face-to-face transactions. Since these services did not lend themselves easily to standardization and trade, the source of growth in productivity and hence incomes. With the industrial revolution in 1900s followed by the spread of the use of Information and Communication News Technologies (ICTs) more recently in 2000s, the ability to trade services has increased significantly. The share or services exports in total world exports of services and good increased from 8% in 1970s to about 19% in 2014, and the share of services export in world Gross Domestic Product (GDP) increase more than twice from less than 2% in 1970 to more than 6% in 2014 . According to Prakash *et al.* (2017), the ability to trade services has increased significantly

thanks to technology and service exports now account for almost a quarter of total exports. Service exports have also come to play a central role in global production networks and value chains. The main reason for the increased tradability of services is the revolution in ICTs and a declining trend in communications and telecommunications costs in many countries. That led to an increasing internet adoption around the world, coupled with a rapid proliferation of broadband internet services that have made arm's length delivery of services possible within and across borders on countries an continent. For example, if a haircut still requires moving to the nearest haircutter or barbershop, many other services no longer require the provider to be close to the customer. Mailing services and even financial services are global and many consulting services, such as architectural designs, can be delivered from anywhere. Prakash *et al* (2017), also show that, thanks to ICTs progress, more and more manufacturing industries services are now tradable across countries. Trade is increasingly shifting away from manufactures into services with many added values in term of productivity at the macroeconomic level, with implications at the level of individuals or households.

The digital economy also has huge potential to enhance social wellbeing. Inequality, by definition, means that people do not have the same access to scarce resources, and that some do not have any access. New technologies in some cases can eliminate that scarcity. For example, new technologies can leverage human brain capacities and cognitive skills in similar ways to earlier breakthrough technologies, such as steam power and electricity, which magnified human physical strength. This holds the promise of similar or even greater increases in living standards, considering that digitized information can be reproduced at low cost and used simultaneously thus being far less subject to scarcity. Digital technologies can also promote social inclusion by creating better access to quality education and offering new opportunities for skills development (OECD, 2014a). Digital learning environments can enhance education in multiple ways, for example by expanding access to content to people from low-income backgrounds or disadvantaged areas, supporting new pedagogies with learners as active participants, fostering collaboration between educators and between students, and enabling faster and more detailed feedback on the learning process. Similarly, several authors argue that digital technologies have enormous potential to innovate and improve the quality of teaching, and more in general the learning experience (Yusuf, 2005; Jhurree, 2005; Hepp *et al*., 2004).

Some other scholars moved to study how digital technologies can affect wellbeing. For example, Atkinson and McKay (2007) argue that digital technologies are improving healthcare, access to education, the monitoring of the environmental quality, and that they are giving consumers the possibility of interacting more fluidly with business and governments. In fact, a sort of new industrial revolution is upon us, coupled to the social digital transformation carried by the Media, Entertainment and Information Industries (MEII). Since they provide the digital tools, services, applications and content we engage with, increasingly anytime and anywhere. Caceres B. (2007) focused on digital poverty in Peru and found that almost 70% of households are extremely digitally poor. They have no access to the internet, mobile and fixed phone, and receive information on through television and radio set. She argued that digital poverty does not exactly match economic poverty, digital poverty cuts along economic lines and there is more digitally poor households than economically poor ones. Moreover, main variables explaining digital poverty are electricity supply that determine the level of connectivity attained, income and education level achieved. Kanbur (2017) paid attention to the digital revolution and targeting public expenditure for poverty reduction. He revisits the fundamental of the theory of targeting to pinpoint the possible impact of the digital revolution of three dimensions that are information costs, high implicit marginal tax rate and political economy. He show that, digital revolution does not necessarily address all these issues in reducing poverty and may worsen the tradeoffs in certain situations, namely in terms of information cost in the absence of detailed income, consumption and living conditions data at the individual or household level.

More recently, Longmei and Sally (2019) argued that the net impact of digitalization on income

inequality is uncertain. Using Chinese's data, they show that, on the one hand, digitalization can help targeted poverty reduction, in particular by linking suppliers in remote regions to consumer markets in the metropolis. They add for example that, Alibaba's e-commerce platform has promoted the development of more than 1300 "Taobao villages" in China. Digitalization also contributed to increasing financial inclusion in China, by providing easy mobile access of various financial services to rural residents (World Bank, 2017). On the other hand and according to them, the disruptive impact of digitalization would mostly be borne by relatively low-skilled workers, while high-skilled workers will likely benefit more with rising employment and faster wage increases, thus potentially widening inequality. In China, inequality has been on a modest downward trend (which has stalled in recent years) post GFC despite the rapid digitalization, reflecting both structural forces and proactive government policies to reduce inequality.

In this paper ICTs related services take into account connectivity, information, communication, and technology. Connectivity is seen through a means of communication that include end-user equipment, fixed or wireless network. Connectivity needs can be met with having access to and using radio receivers, television devices, fixed or mobile telephone services, and /or computers. Regarding information, it is having access to it through any means enabling creation, storage, diffusion, exchange and consumption. Communication is related to the type of means used to be connected. Technology is linked with Research and Development to improving the service quality.

Recent trends of digital economy in Cameroon

In the recent past, Information and knowledge have emerged as major sources of wealth in Cameroon. There is a digital revolution and it has impact and influence on the consumers, producers, investors, exporters, importers, public policy makers, academics, students, consultants, administrators, lawmakers and all others actors directly or indirectly involved in various processes of the new economy called digital economy. Some stylized facts of the digital revolution in Cameroon are showned below. We can notice the rapid increasing number of subscriptions to mobile cellular from 103, 279 in 2000 to 16,806,894 in 2015 (Figure 2), compared to the subscribers to fix telephone during the same period (Figure 1)

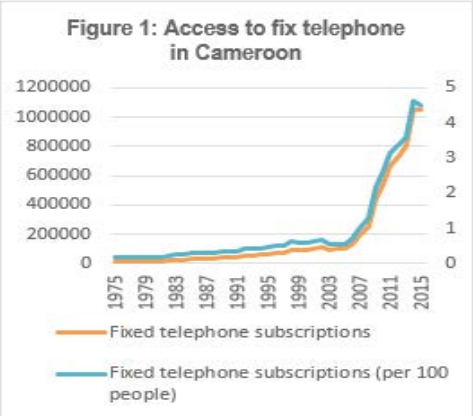

Figure 1. Access to fix telephone in Cameroon

Source: Authors with NIS data

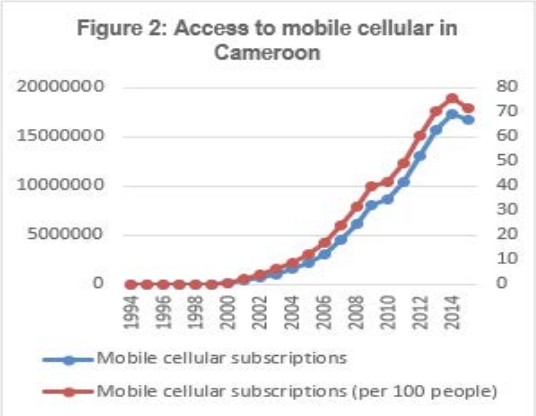

Figure 2. Access to mobile cellular in Cameroon

In 1997, less than 1% of the population has access to internet, but today there are more than 20% using internet facilities, coupled with an increase of fixed broadband subscription per 100 people from zero to 8% during the last decade.

Another fact of the digital revolution is the use of social media. In Cameroon we notice about 2,100,000 facebook's subscribers in 2017 (they are 146,637,000 in Africa), with facebook being the most used social media in Cameroon (92,11%) as it is also the case in Africa (86.75%) and worldwide (80.31%).

According Global Web Index 2017 statistics, Whatsapp is the most frequently used social platform with 58% of its users online more than once a day.

Table 1. Social Media Statistics in Cameroon - December 2017

Facebook	92.11%
WhatsApp	62%
Pinterest	5.46%
Viber	40%
Snapchat	1%
YouTube	0.68%
Twitter	1.36%
Instagram	30%
LinkedIn	0.12%
Google+	0.1%

Table 2. Social Media Statistics in Africa - September 2017

Facebook	86.75%
WhatsApp	60%
Pinterest	4.55%
Viber	41%
Snapchat	3%
YouTube	4.02%
Twitter	3.62%
Instagram	0.21%
LinkedIn	6%
Google+	0.18%

Table 3: Social Media Statistics Worldwide - September 2017

Facebook	80.31%
WhatsApp	70%
Pinterest	8.39%
Viber	45%
Snapchat	10%
YouTube	1.82%
Twitter	6.01%
Instagram	1.07%
LinkedIn	16%
Google	0.83%

Source: Authors with Stat Counter, Global Stats and Miniwatts Marketing Group data

Financial services are also influenced by digitalization in Cameroon. Between 2014 and 2017, we notice the decreasing number of people having an account in financial institution (Figure 5), while the number of people using a mobile account is increasing (Figure 6).

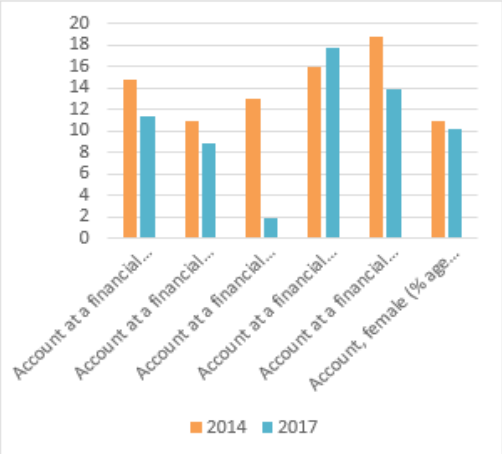

Figure 5. People having an account at a financial institution

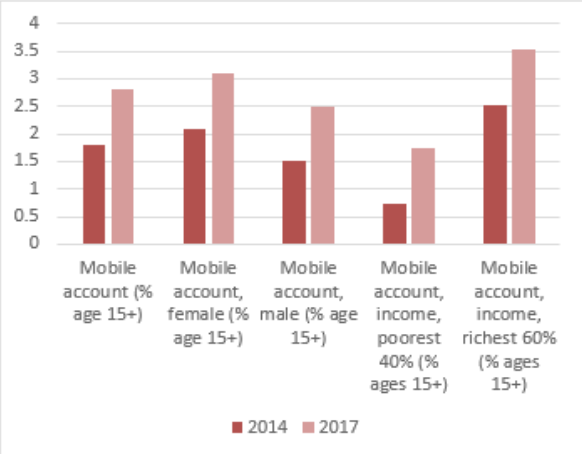

Figure 6. People having a mobile account

Source: Authors with NIS data

Regarding communication and computer services the introduction of new ICT in Cameroon in 2000 led to the simultaneous increase of services and commercial imports and exports, but with an higher level of imports (Figures 7 and 8)

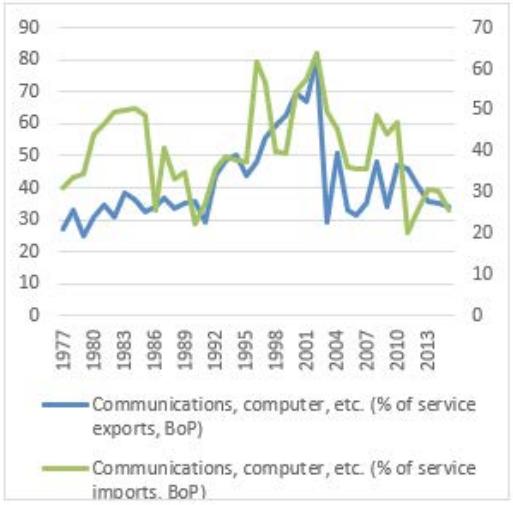

Figure 7. Communications and Computer services

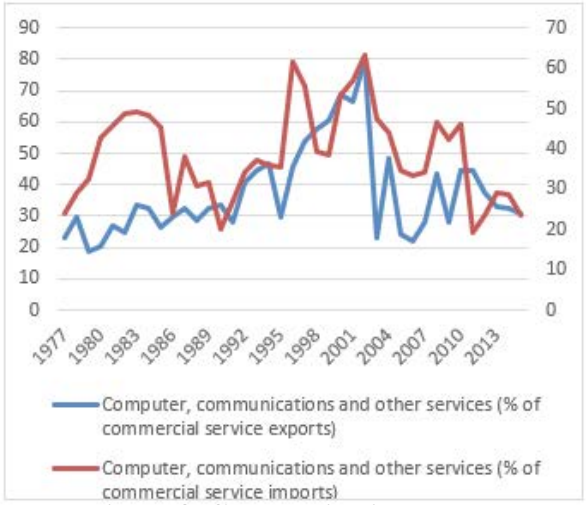

Figure 8. Communications and Computer commercial services

Source: Authors with NIS data

As far as international trade is concern, ICT goods imports show an increasing trend in the last decade (Figure 9) while ICT services export is also increasing but rather slowly (Figure 10)

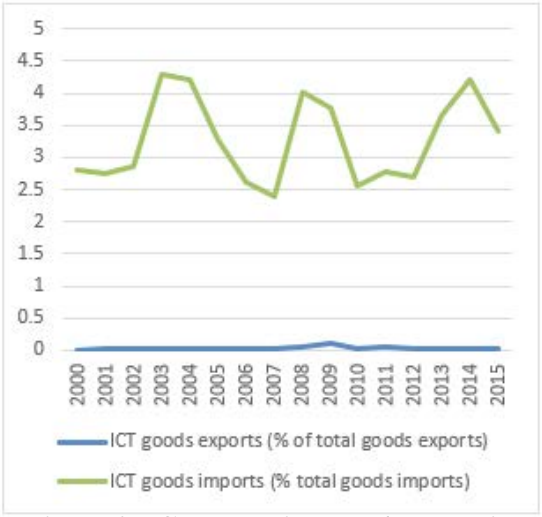

Figure 9. ICT goods imports/exports in Cameroon

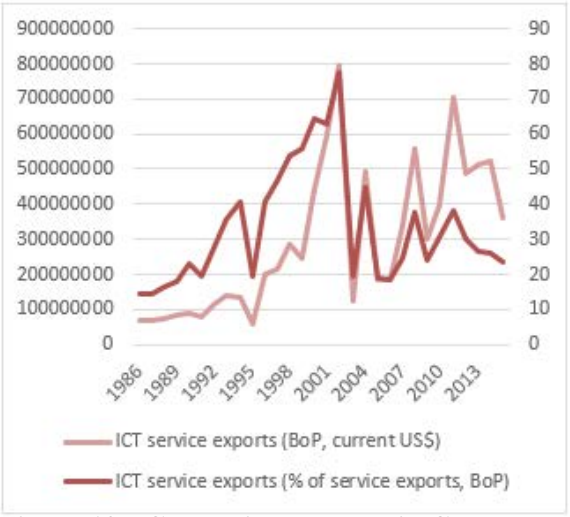

Figure 10. ICT services exports in Cameroon

Source: Authors with NIS data

At the same time, due to digitalization we also notice an increase in high technology exports in Cameroon from 3.1% in 1990 to more than 5% in 2010 as shown on Figure 11, coupled with the growing investment in telecoms with private participation, despite negative effects of crisis (economics, financial, budgetary, security) in 2010s.

All these facts coupled with the increase in the services added value (Figure 13) within the digitalizing economy system, lead to an improvement of wellbeing at the individual level in Cameroon that can be seen through the continuous growth of Gross Domestic Per Capita (GDPPC) since 2000 that represents the introduction periods of new ICTs in Cameroon; or even through the positive trend of Health Expenditure Per Capita (HEPC) from less than USD 100 in 1990s to more than USD 121 in 2015 and the decreasing poverty rate from 53.3% in 1996 to 37.5% in 2014 (NIS, 2014)

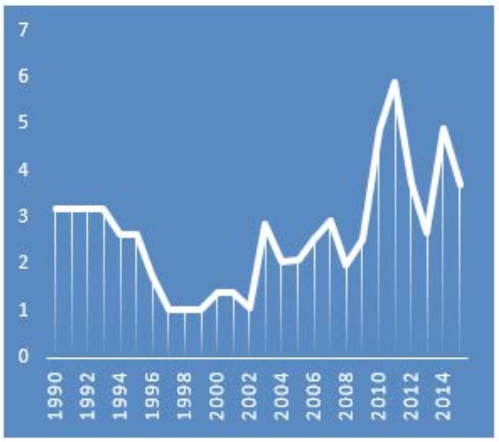

Figure 1 1. High-technology exports (% of manufactured exports)

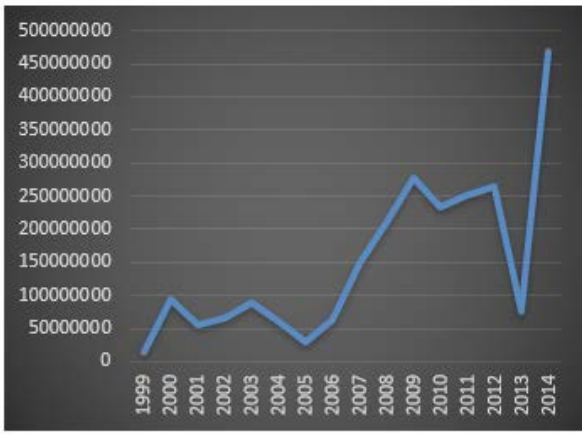

Figure 12. Investment in telecoms with private participation (current US$)

Source: Authors with NIS data

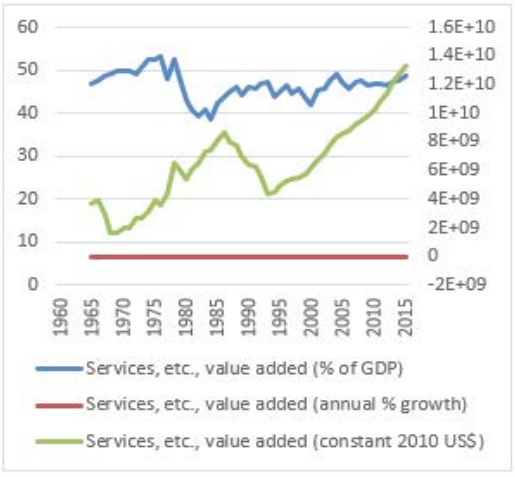

Figure 13. Services added-value in Cameroon

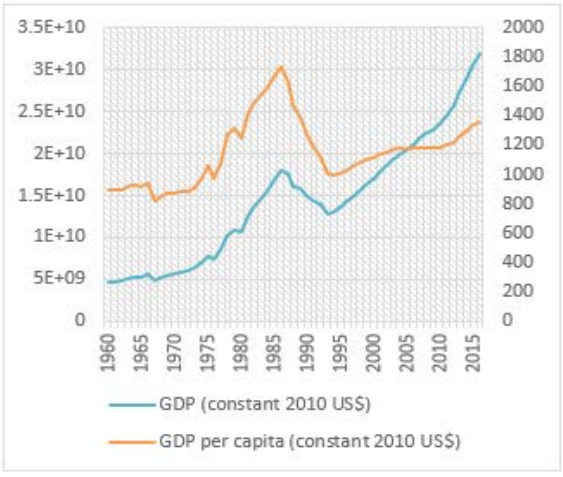

Figure 14. Gross Domestic Product Per Capita

Source: Authors with NIS data

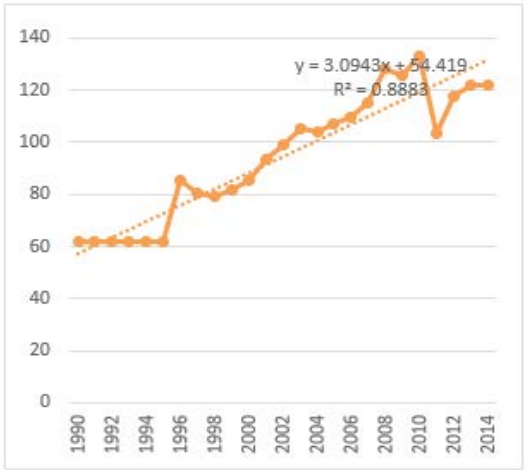

Figure 15. Health expenditure per capita, PPP (constant 2011 international $)

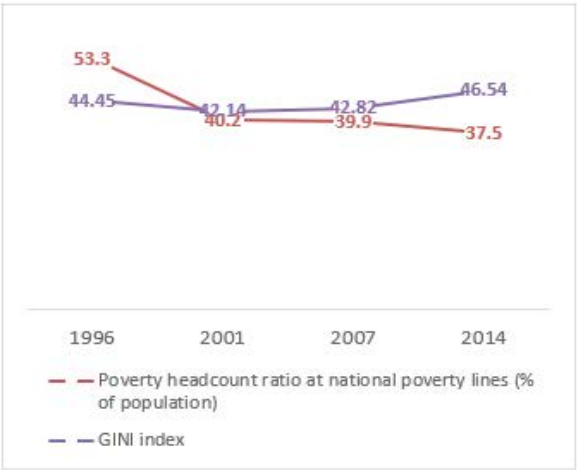

Figure 16. Poverty and inequality trend

Source: Authors with NIS data

According to the results of the last Cameroonian Households Consumption Surveys (CHCS4) in 2014 concerning the main activity of household's head, extremely digitally poor people undertake agricultural or farming activities, while wealthy people undertake service activities (NIS, 2015). It is important to note that unemployed people prevail among the digitally poor individuals, while heads of the households who undertake service activities prevail among the connected people. In addition, among connected people there is a large number of households where the head of the household is unemployed. Regarding labor market information, since having a job can help move people out of poverty, the level of access to job market information in general is quite limited among the extremely digitally poor people. The connected people are better on average than the digitally poor people, while the digitally wealthy people have access to all job market information.

There are also huge challenges for all goods and services based on ICTs that determine their response to the fast moving societal changes, additions and modifications in the Information, Communication, Technologies (ICTs) and their applications. Since 2009, the Cameroonian Government is implementing its Growth and Employment Strategy Paper (GESP), with an emphasis in the sector of Information Technology and Communication (ICT) that has implications to other sectors strategies.

The first challenge is access to electricity. In Cameroun only about 56.8% of the entire population has access to electricity among which most them are settled in urban area where about 86.51% of the urban population has access to electricity (Figure 17).

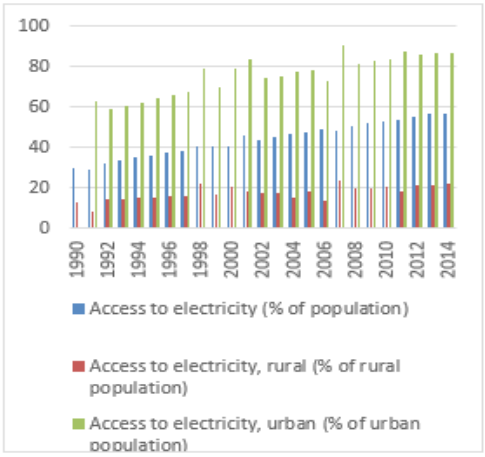

Figure 17. Access to electricity in Cameroon

Figure 18. Electric power consumption (kwh per capita)

Source: Authors with NIS data

As digitalization is moving into Cameroon, the electricity demand is rapidly increasing with an electricity power consumption per capita that grew for more than 40% between 1990s and 2000s, from about 200.166 Kwh to more than 280 Kwh as shown on Figure 18.

Methodology

Effects of digitalization on wellbeing. Concerning the methodological framework, our aim is to develop a model of optimal sequences of decision putting on evidence the expected utility as one of the main determinant of engaging in digital technologies. More specifically, we model individual decisions to use digital technologies as an additional utility search problem. We assume an economy with a labor force of size comprising low-skilled, average or middle skilled and high skilled workers and earning a specified wage. The production within the economy is based on

a Constant Elasticity Substitution (CES) function. Another basic assumption is that wages are local prices of individual's skill bundles. Individuals know their utility in their current position. To determine the utility in another position, it is necessary to move to digital technologies. This move is subject to a cost for the individual so that he/she may be more productive in some positions than in others, due for example to Media, Entertainment and Information Industries, working conditions, residential conditions, local amenities, etc. The utility gained in each position may be interpreted as the best offer available in that position. We assume that the marginal utility of income is constant and that individual can borrow and lend without restriction at a given interest rate to pay for access digital technologies. In this regards, expected utility maximization reduces to maximization of expected lifetime income, net of digital technologies cost, with the understanding that the value of amenities is included in income and that both amenities values and moving costs are measured in consumption units. We set vectors of our value function VF of an individual which includes wage and preference information, current location and age. The utility flow for someone who choose to move to the position p is specified as $U(s,p)+\gamma_p$, where γ_p is a random variable that we assumed to be independent and identically distributed across position destination of individuals and across years, and independent of our above-mentioned state vector. Our decision problem is formalized as follow:

$$VF(s,\gamma) = Max\left[V(s,p) + \gamma_p\right],$$

where $V(s,p) = U(s,p) + \alpha \sum_{x'} Pr(x'|x,p)\bar{V}(x'),$

and $\bar{V}(s) = E_\gamma VF(s,\gamma).$

α can be define as the discount factor and E_γ refers to the expectation with respect to the distribution of the p-vector γ with component γ_p. We then compute the value function, take into account age as a state variable and thanks to successive iteration and discrete dynamic programming we put on evidence decisions of individuals to use digital technologies.

Data

Our data are form the National Institute of Statistics (NIS) of Cameroon. They are microeconomic data from Cameroonian Households Consumption Surveys (CHCS). They are official surveys of the NSI making data available for 1996, 2001, 2007 and 2014.We also use data of the 2018 World Development Indicators (WDI) from the World Bank.

The location of each individual is recorded at the date of the survey. In order to obtain a relatively homogeneous sample of the economic active population, we only considered individuals who in terms of educational attainment completed at least post-secondary. Our analysis sample contains 811 individuals and each of them is a household head.

Computation and empirical implementation

Cameroon is made-up of P=10 regions. Let us consider each of them like a position or location of the individual or a labor market, so that we have ten labors markets. A given individual chosen in any position knows about the value of human capital and wage in that location but knows less or not about them in another location. We assume that it is not possible to fully know about utility to be gained, wage, human capital or any other components of VF in all the 10 locations. We presume that the number of wage observations cannot exceed a number Q (Q<P) . If the distribution of location match utility and others preference components in each of the P=10 regions have for example r points of support, the number of states for an individual seen in Q locations is then $P(Pr^2$

$)^Q$. If for example, P=10, r=4 and Q=2, the number of state for each individual at a given age (age is taken as from 25) is then 256,000. As done by Kennan *et al.* (2011), we use this approximation to reduce the number of states in a most obvious way as someone having all the information available in the big state space and is simply reassigned to the lesser information state. Kennan *et al.* (2011) in term of income expected and individual migrations decisions argued that it is not enough to keep tract of the best wage found so far, since the payoff shocks may favor a location that has been previously abandoned. And it is necessary to know the wage at that location so as to decide whether to go back there, even if it is known that there is a higher wage at another location.

The wage W of a given individual i in a position p at age a in the year t is given by the following relation

$$W_{ip} = \pi_p + V_{ip} + G(s_i, a, t) + \beta_i + \delta_{ip}(a)$$

π_p is the average wage in the position p, V is the permanent matching effect in the current position and the linear time effect and the effects of observed individuals characteristics is captured by G (s_i, a, t). β_i shows an individual effect fixed across various positions and δ_{ip} (a) is the transient effect. In this paper, V,β and δ are assumed to be independent random variables, identically distributed across our 811 individuals and 10 positions. And any individual has the information about the outcome of V and β.

The shape of the functional form or the relationship between wage level and the decision for an individual to move to digital technologies is determined by the difference between the quality of the match he is able to make in his present position captured by π_p+V_{ip}, and the expectation of obtaining a better matching in another position b measured by π_b+V_{ib}. We assume that other component of wage are not directly related to the decision of moving or not to digital technologies. Therefor an individual know about his final utility VF (s,γ) in his current position, but the one in others positions is simply a random variable. Decision to use digital technologies or not is subject to the difference between the expected utility than can continuously be obtained in the present location and the expected utility obtained in another position through moving to the use of digital technologies.

Let $l=(l^0,l^1,\ldots\ldots l^{(Q-1)})$ be a Q vector containing a sequence of recent position for an individual, beginning with his current position. Let W be a Q vector recording wage and utility information at these locations. The state vector s consist of l,W and the individual's age. The flow payoffs for someone whose home position is h is modeled as follow:
$\tilde{u}_h=u_h(s,p)+\gamma_p$, where

$$u_h(s,p) = \lambda_0 W(l^0,\omega) + \sum_{k=1}^{K} \lambda_k Y_k(l^0) + \lambda^H \chi(l^0 = h) + \zeta(l^0,\omega) - \Delta_{\tau(s,p)}$$

In this equation, the first term refers to wage income in the current position, Y_k (l^0) is a nonpecuniary variable representing amenties values, λ^H is a premium allowing each individual to have a preference for his native position, χ denotes an indicator meaning that A is true, and ζ is the random component.

For a given individual of type τ to move from position l^0 to position l^p, he needs to cover a certain distance D(l^0, p) between the two positions and support the related cost denoted by Δ_τ (s,p):

$$\Delta_\tau(s,p) = \left[\varphi_{0\tau} + \varphi_1 D(l^0,p) - \varphi_2 \chi\left(p \in \mathbb{A}(l^0)\right) - \varphi_3 \chi(p = l^1) + \varphi_4 a - \varphi_5 n_p\right]\chi(p \neq l^0)$$

Where, n_p is the size of the population in the region or position p and A(l^0) represents the set of

positions adjacent to l^0. We assume that moving to an adjacent position is always costless, but not moving back to a previous position. In fact and as far as its shape is concerned, the moving cost is an affine function of the distance.

Regarding the transition probability from a position to another, let us consider a state vector s=(s̃,a) with $\tilde{s} = \left(l^0, l^1, s_v^0, s_v^1, s_\zeta^0, s_\zeta^1\right)$, and where s_v^o is the index of the realization of the position match component of wages in the current position and similarly for others components. Finally, the transition probabilities is computed as follow

$$Pr(s'|s,p) = \begin{cases} 1 & if\ \ p = l^0, \tilde{s}' = \tilde{s}, a' = a+1 \\ 1\ if\ p = l^1, \tilde{s}' = \left(l^1, \right. & \left. l^0, s_v^1, s_v^0, s_\zeta^1, s_\zeta^0, a' = a+1\right) \\ \frac{1}{n^2}\ if\ p \notin \{l^0, l^1\}, & \tilde{s}' = \left(p, l^0, x_v, s_v^0, x_\zeta, s_\zeta^0\right), \\ (1,1) \le \left(x_v, x_\zeta\right) \le \left(n_v, n_\zeta\right), & a' = a+1, \\ 0 & otherwise \end{cases}$$

According to this formula,
-If no move to another position occurs in the current period, the state s remains the same but the age component can varies.
-If there is a move from the use of digital technology (new position) to a previous position (no use of digital technology), the two positions are interchanged.
-If is there is a move to a new position, the current position becomes the previous one and the new position match components are drawn at random.

Let us mention that in all possible situations, the variable age is incremented by one period. We should also be cautious with homogeneity of our microeconomic data. Since if even our sample is quite homogeneous, measured income in household consumption surveys are variable across the time and from one individual to another. We then specify a wage components model that is flexible enough to fit the nature of our data. It enable us drawing reasonable inferences about the shape of the relationship between measured income and realized values of position match component. There are then a fixed effects and transient wage component to take into account. Regarding the fixed effect (β), we use an uniform discrete distribution symmetric around zero. For the above-mentioned transient component (δ), we use a continuous distribution that allow to incorporate the variability of income. According to us, the best suited way is to draw δ from a normal distribution with its parameters $(0, \sigma_\delta)$.

It is also important to take into account observed information or history of each individual as mixture of heterogeneous component. For this purpose, for and individual i, we use a likelihood function $L_i(\theta_\tau)$ where for somebody of type τ the parameter vector is θ_τ and the probability is ϕ_τ. The sample log likelihood is given by the following

$$\Lambda(\theta) = \sum_{i=1}^{N} \log\left[\sum_{\tau=1}^{K} \phi_\tau L_i(\theta_\tau)\right].$$

Let us add that at each period of an individual i history, two piece of information contribute to $L_i(\theta_\tau)$, they are the observed earning and the position choice. Each piece involves a mixture over the possible realizations of the various unobserved components. In fact; in each position, there is a draw from the distribution of position match wage components which is modeled as an uniform distribution over a finite set Ψ={v(1),v(2),……v(n_v) }. This set is index by w_v with w_v (p) representing the match component in position p, where $1 \le w_v(p) \le n_v$. In this paper, for empirical implementation, we set α=0.8, t=3 and Q=2.

Results

Our main findings (Tables 4, 5 and 6) show two versions of our model with coefficients and standards errors. We see that distance between main cities (regional capital) from the previous position, characteristics/standards of house, place of living (rural/urban), marital status and households size are significant as per regard to the decision of an individual (who is the household head as stated before) to change his/her current position through moving to digital technologies. Individual's age, level of education (more than post-secondary achieved), and current status in employment (wage/ grade /year of experience) are also significant. Controlling for these parameters, moving decision to digital technologies and changing the current position are significantly affected by expected wage/ grade in the new position. The elasticity of the relationship between wage and digital technologies use is closed to 0.75. Such results stand like an optimal search of the best wage matching with the position of an individual in a given place since workers receiving their expected income in the current position have a great probability to stay without being tempted to use digital technologies to move to another position. We suggest to policy makers development of ICTs infrastructure all over the country. That may lead to an inclusive approach of promoting economic growth and share prosperity.

Acknowledgment

This paper is a contribution to the Fifteenth RUFORUM Annual General Meeting held 2-6 December 2019 in Cape Coast, Ghana.

References

Atkinson, R.D. and McKay, A.S. 2007. Digital prosperity: understanding the economic benefits of the information technology revolution. SSRN 1004516.

Baumol, W. 1967. Macroeconomics of unbalanced growth: The anatomy of urban crisis. *The American Economic Review* 57: 415 -426.

Bukht, R. and Heeks, R., 2017. Defining, conceptualising and measuring the digital economy. *Development Informatics Working Paper* 68: 1-24.

Cáceres, R.B., 2007. Digital poverty: Concept and measurement, with an application to Peru. *Institute of Peruvian Studies Working Paper* 337: 1.35.

Clerides, S.K., Lach, S. and Tybout, J.R. 1998. Is learning by exporting important? Micro-dynamic evidence from Colombia, Mexico, and Morocco. *The Quarterly Journal Of Economics* 113 (3): 903-947.

Hepp, P., Hinostroza, J.E., Laval, E. and Rehbein, L., 2004. Technology in schools: Education, ICT and the knowledge society. pp. 30-47. In: World Bank, Distance & Open Learning and ICT in Education Thematic Group, Human Development Network, Education.

Jhurree, V. 2005. Technology integration in education in developing countries: Guidelines to policy makers. *International Education Journal* 6 (4): 467-483.

Kaldor, N. 1967. Strategic Factors in Economic Development. New York, Ithaca.

Kanbur, R. 2017. The digital revolution and targeting public expenditure for poverty reduction. Digital Revolutions in Public Finance. 225 pp..

Pantea, S. and Martens, B. M . 2014. The value of the internet for consumers. Institute for Prospective Technological Studies, European Commission Joint Research Centre Technical report. Digital Economy, Working Paper N° 2014/08, 24 pp.

Prakash, L., Saurabh, M., Chris, P. and Ke Wang. 2017. The future wealth of nations: world trade in services. *Research summary in IMF Research Bulletin* 18 (1) 4-7.

World Bank. 2016. Digital dividend, World Bank report. World Bank Group.

Yusuf Mudasiru, O. 2005. Information and Communication Technology and Education: Analyzing the Nigerian national policy for information technology. *International Education Journal* 6: (3)

316-321.
Zhang, M.L. and Chen, M.S. 2019. China's digital economy: Opportunities and risks. International Monetary Fund.